

Additional Drive Circuitry for Piezoelectric Screw Motors

A single driver can be used to control as many as 16 motors.

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Modules of additional drive circuitry have been developed to enhance the functionality of a family of commercially available positioning motors (Picomotor™ or equivalent) that provide linear motion controllable, in principle, to within increments ≤ 30 nm. A motor of this type includes a piezoelectric actuator that turns a screw. Unlike traditional piezoelectrically actuated mechanisms, a motor of this type does not rely on the piezoelectric transducer to hold position: the screw does not turn except when the drive signal is applied to the actuator.

In the original application for which these modules were developed, a clockwise-vs.-counterclockwise asymmetry in the pulses generated by a driver module that operates at a rate of ≤ 1 kHz made it impossible to reliably command the advertised ≤ 30 -nm steps in either direction. In addition, the original application in-

volved low-duty-cycle operation, which offered the opportunity to reduce cost by using a single driver module with multiplexing circuitry to drive several motors. There was an additional desire to modify the motors by integrating limit switches into them to provide calibration and position-reference signals.

Because of the highly specific nature of its origin, a module of the present type is denoted a Picomotor break-out box. It is designed to be installed and operated in conjunction with (1) an improved, high-voltage driver module, developed specifically for use with a motor of the type in question, that operates at a rate ≤ 2 kHz; (2) a commercial digital input/output module; and (3) a commercial counter/ timer module. Among other things, a Picomotor break-out box affords a capability for multiplexing of output for low-duty-cycle control of as

many as 16 motors. The circuitry in the break-out box includes a commercial gate array that can be triggered by a limit switch to immediately stop the pulse train fed to the driver module, thereby eliminating what would otherwise be the latency involved in stopping motion via software. Also included in the break-out box are power supplies for the driver module and accessory signal boards. The break-out box and the driver box are connected by a single cable that can be up to 130 feet (39.6 m) long, so the thermal pollution of the power supplies can be physically isolated from the actuators.

This work was done by Robert Smythe, Dean Palmer, Yekta Gursel, Leonard Reder, and Raymond Savedra of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-30359